375-2108

November 29, 1995

Ms. Lou Moore
Montana Department of Environmental Quality
Energy Division
P.O Box 202301
Helena, Montana 59620-2301

Dear Ms. Moore:

This letter is in response to your request for an economic comparison of 1992 and 1993 Model Energy Codes for small commercial buildings. Due to your need for this information by December 1, I will have to make use of our existing analyses to the largest extent possible. In the rest of this report, energy use is viewed in terms of differences in annual energy usage in kBtu/ft^2/year for a number of building types in a climate similar to that of Montana. Cost impact is viewed in terms of differences in construction cost.

Background: Montana currently requires the use of the 1992 CABO MEC for all commercial buildings. The 1992 CABO MEC, in turn, contains requirements taken from ANSI/ASHRAE/IES Standard 90A-1980 and contains an exemption for commercial buildings built to the requirements of ASHRAE/IES Standard 90.1-1989. Thus, a commercial building may meet the requirements of the 1992 CABO MEC by following either ANSI/ASHRAE/IES Standard 90A-1980 or ASHRAE/IES Standard 90.1-1989. Montana is considering adoption of the 1993 MEC that would in effect require the use of ASHRAE/IES Standard 90.1-1989, thus eliminating the use of ANSI/ASHRAE/IES Standard 90A-1980.

Energy Use Impacts: A recent PNL report (Hadley and Halverson, 1993) examined the energy use of ten building types in six climatic regions of the United States under three different building standards (including ANSI/ASHRAE/IES 90A-1980 and the Federal standard-technically equivalent to ASHRAE/IES Standard 90.1-1989). I have enclosed a copy of this report but will summarize the important results with special attention to the results that impact Montana.

The ten building types were: Apartment, Small Office, Medium Office, Large Office, Church,

School, Hotel, Anchor Retail, Strip Shopping Mall, and Warehouse. These ten buildings represent real buildings designed and built in the mid-1980's and used in a number of standards development activities by ASHRAE and DOE.

The six climatic regions were represented by: El Paso, Texas; Lake Charles, Louisiana; Madison, Wisconsin; Los Angeles, California; Seattle, Washington; and Washington, D.C. The Madison, Wisconsin is probably the closest to that of Montana. The three different building standards compared were: ANSI/ASHRAE/IES Standard 90A-1980; 10 CFR 435 - the current Federal standard (which is almost identical to ASHRAE/IES Standard 90.1-1989 in terms of technical requirements); and 10 CFR 435 with reduced lighting power allowance.

The portions of this report applicable to Montana's question are the comparison of 10 CFR 435 to ANSI/ASHRAE/IES Standard 90A-1980 for all building types in Madison, Wisconsin. Granted that Madison is not in Montana, or even particularly close, but it has a very similar climate to the major metropolitan areas of Montana, as shown by the table below: (Data taken from ASHRAE/IES Standard 90.1-1989, Appendix C).

City	Heating Degree Days	Cooling Degree Days
Billings, MT	7156	598
Great Falls, MT	7454	450
Madison, WI	7466	542
Missoula, MT	7560	221
Helena, MT	7817	328
Miles City, MT	7989	773
Cutbank, MT	8941	117

Madison, WI is seen to very similar in climate to Great Falls and Missoula, and somewhat colder than Billings. Note that all the cities listed above are among the nine Typical Meteorological Year (TMY) weather sites found in Montana.

The results of the study may be viewed either across all buildings simulated in Madison, WI or by building type. Table 3.2 (page 3.14 of the report) shows that for all ten building types, annual energy usage decreased from 89 to 77 kBtu/ft^2/yr going from ANSI/ASHRAE/IES Standard 90a-1980 to a standard that is technically equivalent to ASHRAE/IES Standard 90.1-1989. This represents a 13% savings in energy across all ten building types. Appendix B (pages B.1 through B.10) show the following results by building type:

Building Type	Energy Savings	Biggest Savings in
Apartment	7.7%	Heating
Small Office	7.7%	Lights, Heating
Medium Office	9.8%	Lights, Cooling
Large Office	10.3%	Lights, Cooling
Church	11.5%	Heating
School	19.1%	Heating, Lights
Hotel	7.0%	Heating, Cooling

Anchor Retail	21.2%	Lights, Cooling
Strip Shopping Mall	16.6%	Lights, Heating
Warehouse	41.8%	Heating

As can be seen from the table, the energy savings are highly dependent on building type, ranging from less than 8% for residential occupancies (Apartment and Hotel) to over 40% for Warehouse building types. Using these results and an estimate of Montana's new construction volume by square foot, an estimate could be made of the total energy savings that could be obtained in Montana. I do not have an estimate of Montana's new construction starts by building type, but would expect that much of Montana's commercial construction falls in the office or retail categories. Based on the results shown for these categories, Montana can expect that requiring ASHRAE/IES Standard 90.1-1989 will save 8% to 20% of the total energy usage of new commercial construction ASSUMING CURRENT BUILDINGS ARE BEING BUILT TO THE REQUIREMENTS OF ANSI/ASHRAE/IES STANDARD 90A-1980.

Construction Cost Impacts: A companion volume to the energy impacts report mentioned above (DiMassa, Hadley, and Halverson, 1993) included an analysis of construction cost impacts for four of the building types used above (Apartment, Small Office, Anchor Retail, and Strip Retail) and for two different U.S. locations (Los Angeles and Madison). I have enclosed a copy of this report also, but will summarize the results briefly.

The construction cost study found that while energy usage did go down for the buildings when more stringent standards were applied, construction costs did not necessarily go up. This was due to the flexibility built into the newer, more stringent standards that allowed the builder a range of options for meeting the requirements. In some cases, it was found that the same building could actually be built at a lower cost under the more stringent standards. This was attributed mainly to the reduced lighting power requirements, which require fewer lighting fixtures and lower labor costs. The lower lighting power requirements also led to lower cooling loads. The lower cooling loads, combined with changes in envelope requirements and increased HVAC efficiency requirements, allowed the HVAC equipment to be sized smaller and led to additional construction savings.
Overall, it appears likely that buildings built to ASHRAE/IES Standard 90.1-1989 will cost about the same as buildings built to ANSI/ASHRAE/IES Standard 90A-1980. With the construction costs for either standard about the same, the influence of current construction practice is minimal.

While Montana costs would not be expected to be identical to either Los Angeles or Madison, neither of these cities represent extremes in the construction industry and they can probably be considered to be typical of the range of costs that might be found in Montana. The conclusion above about the flexibility of the standards is another issue that deserves another mention. ASHRAE/IES Standard 90.1-1989 offers three distinct compliance paths - prescriptive, system performance, and energy cost budget - each with its' own set of requirements, tradeoffs and costs. ANSI/ASHRAE/IES Standard 90A-1980 offers a single path more or less equivalent to a system performance approach with a different set of tradeoffs and costs. Given the wide range of compliance options under both standards, comparison of construction cost is difficult.

State Code Evaluation Report: As part of PNL's support of DOE's EPAct obligations, we made a study of the energy savings potential in each state due to a switch from the current minimum state code to ASHRAE/IES Standard 90.1-1989 (the minimum commercial code required by EPAct). I enclose a copy of this report also (Schliesing, Halverson, et al. 1995). This is a pre-publication copy, but I would be happy to send you a published copy when it is available. (The report has been scheduled for publication since mid-August, but we haven't gotten it out yet.)

The results of this study, based on simulations for a hybrid Retail/Office building in Great Falls, Montana, and adjusted for new construction trends using DOE's CBECS data set, shows that the energy savings potential for Montana is about 23%. This is on the high end of the estimates from the previous study, but is still in the range expected for office and retail buildings. Again, this number is based on the assumption of ANSI/ASHRAE/IES Standard 90A-1980 as the Montana minimum code.

Please do not hesitate to contact me at (509)375-2108 if you require additional assistance.

Sincerely,

Mark A. Halverson, P.E.
Senior Research Engineer
Building Energy Standards Program

attachments

cc: Craig Conner, PNL
Diana Shankle, PNL
Steve Turchen, DOE
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